Guide for video monitoring of hard bottom benthic communities of the south coast of Newfoundland for aquaculture impact assessments

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2018

Canadian Data Report of
Fisheries and Aquatic Sciences 1284

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Cat. No. Fs97-13/1284E-PDF ISBN 978-0-660-26435-6 ISSN 1488-5395

Correct citation for this publication:

Salvo, F., Oldford, V., Bungay, T., Boone, C., and Hamoutene, D. 2018. Guide for video monitoring of hard bottom benthic communities of the south coast of Newfoundland for aquaculture impact assessments. Can. Data Rep. Fish. Aquat. Sci. Fs 97-13/1284E-PDF: ix + 41 p.

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ABSTRACT

Salvo, F., Oldford, V., Bungay, T., Boone, C., and Hamoutene, D. 2018. Guide for video monitoring of hard bottom benthic communities of the south coast of Newfoundland for aquaculture impact assessments. Can. Data Rep. Fish. Aquat. Sci. Fs 97-13/1284E-PDF: ix + 41 p.

This guide is based on a collection of images of the natural benthic taxa and substrates as well as visual indicators of aquaculture deposition, assessed by drop camera along the south coast of Newfoundland where finfish aquaculture activities are established (i.e. Bay d'Espoir, Hermitage Bay, Fortune Bay, and Belle Bay). This guide can be used as a reference for stakeholders involved in the aquaculture monitoring as part of the *Aquaculture Activities Regulations* (AAR, 2015). Taxa were identified to the lowest taxonomic level according to image quality, AAR reporting needs, and observers' knowledge of species. It is important to note that motile species such as fish, lobster, shrimp and planktonic species were not included for the following reason: effects of potential time of day, seasonal migrations, hiding, attraction, or deterrent behaviours.

RÉSUMÉ

Salvo, F., Oldford, V., Bungay, T., Boone, C., and Hamoutene, D. 2018. Guide for video monitoring of hard bottom benthic communities of the south coast of Newfoundland for aquaculture impact assessments. Can. Data Rep. Fish. Aquat. Sci. Fs 97-13/1284E-PDF: ix + 41 p.

Ce guide est basé sur la collecte d'images de taxons benthiques et de substrats naturels ainsi que sur des indicateurs visuels de dépôt de l'aquaculture évalués par caméra sous-marine le long de la côte Sud de Terre-Neuve où des activités aquacoles de poissons à nageoires sont établies (p. ex., la baie d'Espoir, la baie Hermitage, la baie Fortune et la baie Belle). Ce guide peut être utilisé à titre de référence pour les intervenants qui participent à la surveillance de l'aquaculture dans le cadre du *Règlement sur les activités d'aquaculture* (RAA, 2015). Les taxons ont été identifiés au niveau taxonomique le plus bas en fonction de la qualité de l'image, des exigences en matière de présentation de rapports du Règlement sur les activités d'aquaculture et des connaissances des observateurs des espèces. Il est important de souligner que les espèces motiles comme les poissons, les homards, les crevettes et les planctons n'ont pas été incluses pour les raisons suivantes : les répercussions potentielles du moment de la journée, les migrations saisonnières, les comportements de cache, d'attraction ou dissuasifs.

INTRODUCTION

Since the mid-1980s, finfish aquaculture has occurred in coves located in bays of the south coast of Newfoundland (NL). Monitoring potential disturbance at the seafloor linked to aquaculture activities in NL dictated the use of drop camera monitoring; the hard bottom dominated substrates precluding the use of grabs to detect species or chemistry changes associated with organic deposition originating from farms (Anderson et al. 2005, Fisheries and Oceans Canada (DFO) 2012, Hamoutene 2014, Mabrouk et al. 2014, Hamoutene et al. 2013, 2014, 2015, 2016).

In 2015, the new Aquaculture Monitoring Standard (Monitoring Standard) was developed to harmonize sampling strategy and reporting of benthic composition for hard bottom dominated substrates; it was intended to support the monitoring and sampling requirements of the *Aquaculture Activities Regulations* (AAR) under the *Fisheries Act* (AAR 2015, DFO 2015). Within AAR, benthic environmental assessment is performed by video monitoring (drop camera) at peak biomass with no depth restriction and over transects (number of transect varying with number of cages on site) starting from cage edge every 20 m to 100 m. If indicator species are present or if there is total absence of epifauna in more than 70% of stations the site is not compliant and restocking is not permitted.

Indicator species of enrichment were characterized within the NL context (Hamoutene et al. 2013) and consist of bacterial white mats (previously associated to *Beggiatoa* sp), (Verhoeven et al. 2016) and a new species of opportunistic polychaete *Ophryotrocha cyclops* (Salvo et al. 2014) that forms dense aggregations of on the seafloor. Bacterial mats seem to be more prevalent than polychaetes, even if oxygen depletion and high sulphides may limit their presence (Hamoutene 2013). Recent studies also show that *O. cyclops* have environmental tolerance restrictions and may not be found in low oxygen concentration environments and at shallower stations due to temperature constraints (Hamoutene et al. 2016, Salvo et al. 2017a,b, 2018).

Prior to 2015, a single study described natural hard bottom benthic communities in this region using video (Haedrich and Gagnon 1994). More recent studies show that the

geographical location (Bay) is an important factor explaining composition of natural communities. However, benthic taxa do not always seem affected by depth or substrate but by the interaction between these two factors, even if some organisms show some substrate type or depth preferences (Haedrich and Gagnon 1994, Hamoutene et al. 2015, Salvo et al. 2017a, Hamoutene et al. 2017).

This document aims to update and replace the previous guide available online (DFO 2013) considering the additional images collected since 2013, our better understanding of hard bottom coastal benthic ecosystems of the south coast of NL, and an overall improvement of image quality. This technical report provides the necessary level of detail to enable the production of consistent and high quality data to support the implementation of the AAR (AAR 2015, DFO 2015). The improvement of visual technologies such as camera resolution, or zooming, and/or ROV usage, may provide higher level of details in the future.

MATERIAL AND METHODS

All the extracted pictures presented in this guide were collected using a drop camera video system mounted on a cage frame. The cage frame provided a constant distance between the camera and the seafloor as well as a reference scale. The frame sunk into the substrate at sampling locations where a thick layer of flocculent matter was present (not applicable to most of the videos described in this report). The squared-base that contacted the seafloor had an external square frame of 50 x 50 cm and an internal square frame about 25 x 25 cm (Figure 1). Details on the methodology for underwater video monitoring procedures that was designed for NL regulatory purposes can be found in DFO (2012) and AAR (2015). The underwater camera used was a SV–16HR color camera with a resolution of 550 TVL or SV-DSP-ZOOM2 (Shark Marine) with a zoom or equivalent system. Newer systems are equipped with a zoom camera allowing a better view of some specimens and detection of finer features. Light was provided by two 150W SV–Q10K (Shark Marine) underwater lights pointed downwards to illuminate the quadrats and seafloor. The camera and light systems were connected to a digital video recorder (deckbox) system. Depths greater than 120 m were not sampled. Videos were viewed using videoLAN or imageGrab software and pictures were extracted when

interesting features were visible. GPS coordinates were concealed in the extracted pictures due to a privacy agreement with aquaculture industry.

Only a few benthic organisms could be reliably identified to the genus or species with video alone. However, video did allow the observer to discriminate among most macro-organisms at sufficiently refined taxonomic level (e.g. Family) for use in studies of macro-diversity. With this uncertainty in mind, Species ID when available is provided to the lowest possible taxonomic level, coded in *Red*. Pictures of different substrate categories and visual indicators of aquaculture deposition used in the regulation (AAR 2015) are also provided in this report. Note that each taxonomic group is described according to common name, size, colour, habitat, frequency of observation. For each category where information is missing there is a mention: no information.

LEGEND USED IN CLASSIFICATION

Phylum[P]

Class[C]

Subclass[C]

Order[O]

Family[F]

Genus species[L]

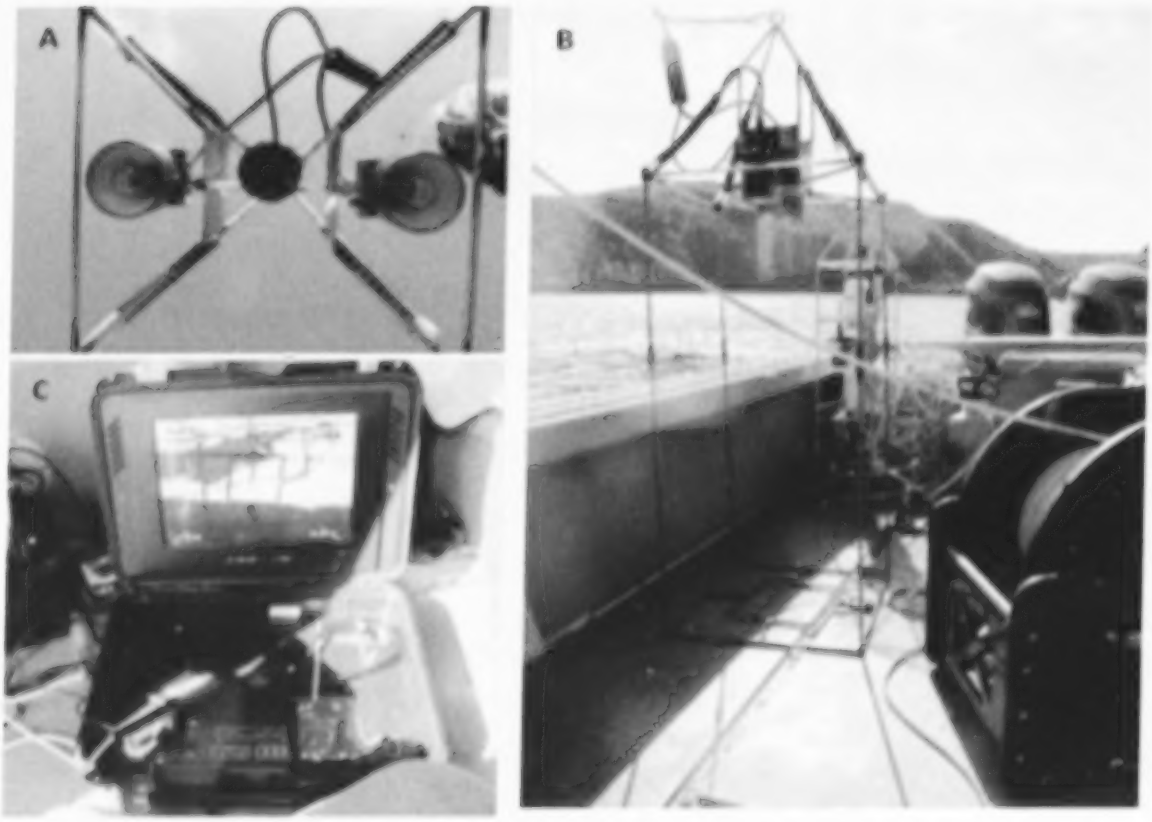


Figure 1: Cage frame mounted with camera system and lights: (A) bottom view of camera and lights, (B) cage frame and camera set up and (C) deck box command – video recorder onboard.

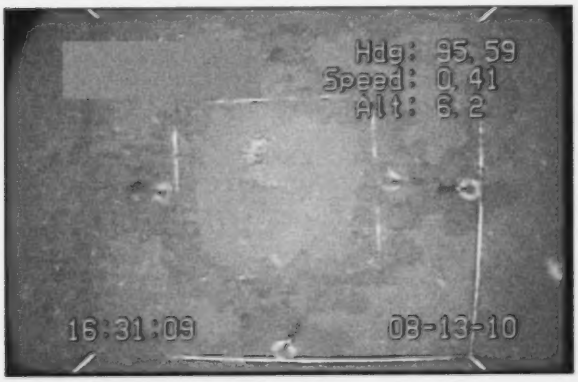
TYPICAL SUBSTRATE TYPES

Based on modified Wentworth scale (1922), Figure 2.

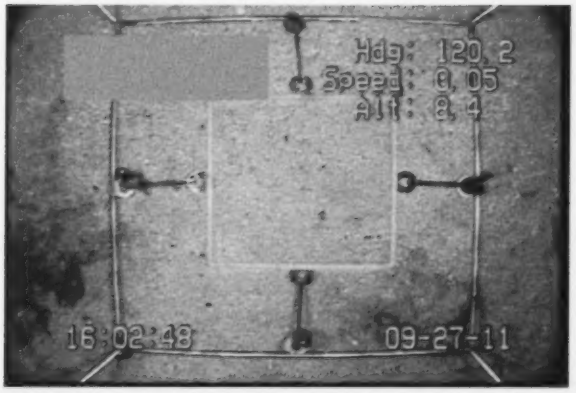
Millimeters (mm)		Micrometers (µm)	Phi (ϕ)	Wentworth size class	
	4096		-12.0	Boulder	
	256		-8.0	Cobble	Gravel
	64		-6.0	Pebble	
	4		-2.0	Granule	
	2.00		-1.0	Very coarse sand	
	1.00		0.0	Coarse sand	
1/2	0.50	500	1.0	Medium sand	Sand
1/4	0.25	250	2.0	Fine sand	
1/8	0.125	125	3.0	Very fine sand	
1/16	0.0625	63	4.0	Coarse silt	
1/32	0.031	31	5.0	Medium silt	
1/64	0.0156	15.6	6.0	Fine silt	Silt
1/128	0.0078	7.8	7.0	Very fine silt	
1/256	0.0039	3.9	8.0	Clay	Mud
	0.00006	0.06	14.0		

Figure 2: Wentworth scale (1922).

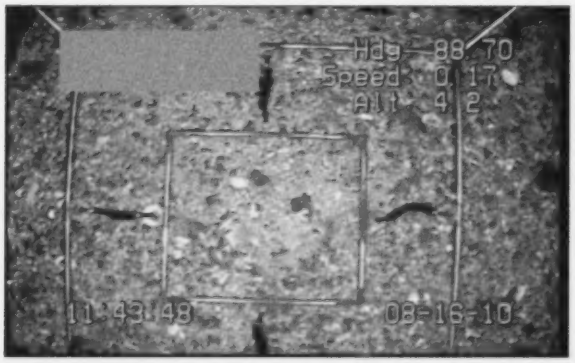
Mud/silt (< 0.06 mm, grains not easily detected by eye)



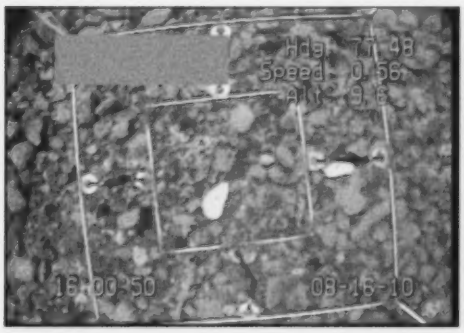
Sand (0.06 to 2 mm)

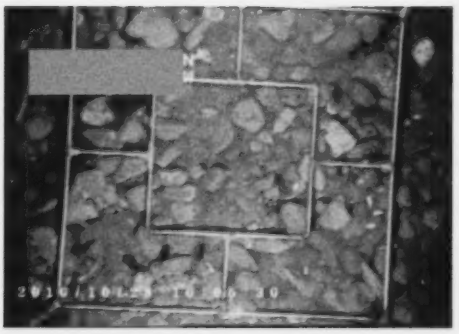


Gravel/Pebble (2-64 mm, grains can be differentiated)

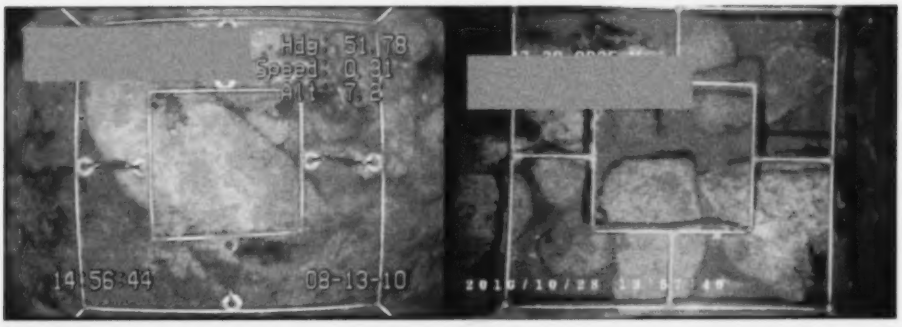


Cobble (64 to 256 cm)

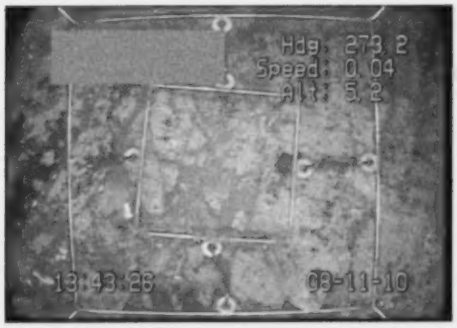




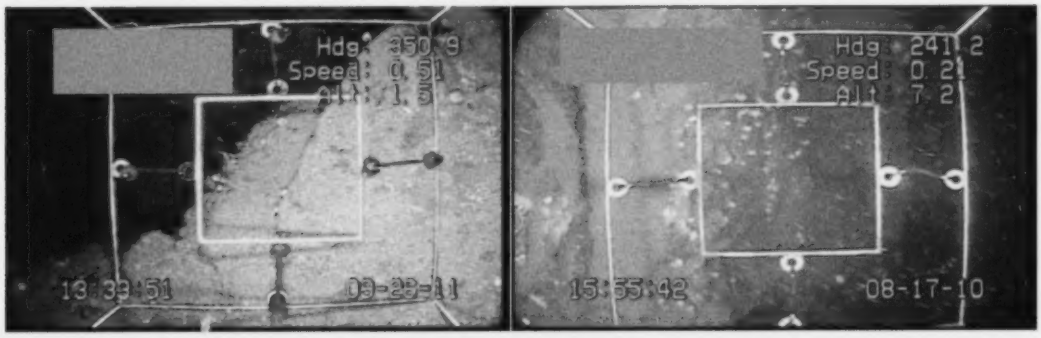
Rubble/Boulder (256 to 4096 mm)



Bedrock/Continuous Rock (> 4096 mm)



Rock Wall/Vertical rock surface



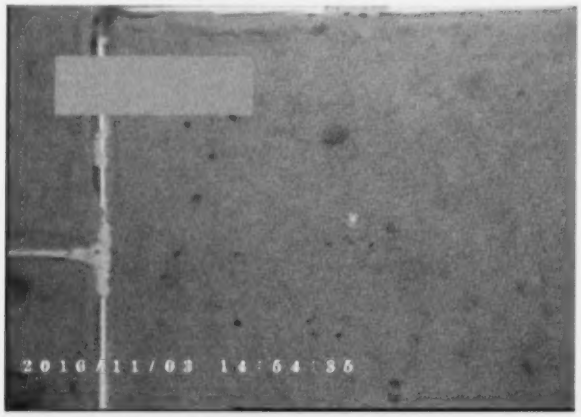
Note: sediment type are often grouped as follows:

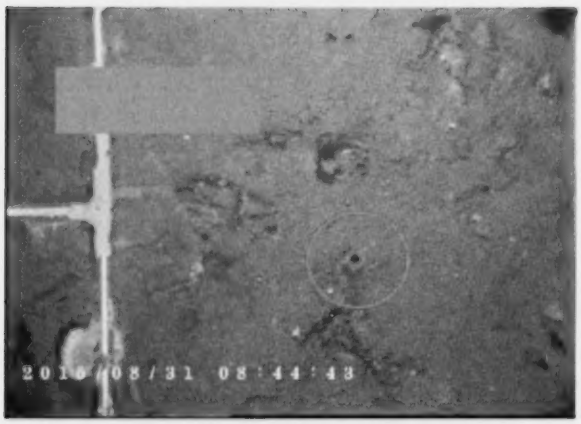
- Soft : < 2 mm
- Medium : 2- 64 mm
- Hard/bedrock : > 64 mm

PRESENCE OF INFAUNA

TRACES OF INFAUNA: OUTCOMING BURROWS (HOLES) IN SUBSTRATE

- Indicates presence of worms, clams or other burrowing infauna.
- Easier to visualize using camera zoom.



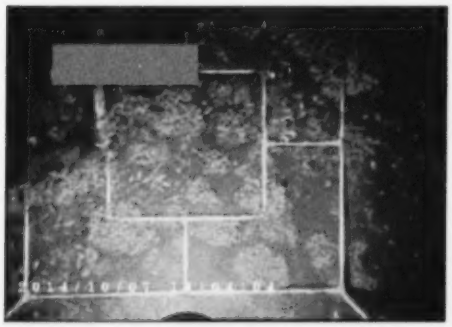


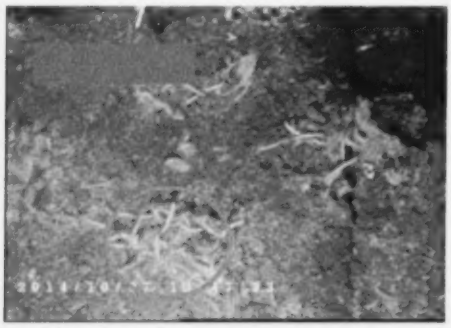
VISUAL INDICATORS OF BENTHIC CHANGE DUE TO AQUACULTURE

BIOLOGICAL INDICATORS

Opportunistic Polychaete Complex (OPC)

OPC are associated to *Ophryotrocha cyclops* (Salvo et al. 2014)

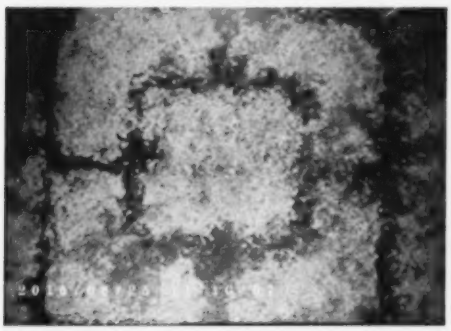


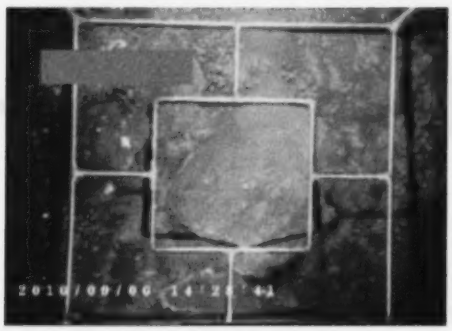


White Bacterial Mats

Often referred to in the past as ***Beggiatoa* mats**

(may appear yellow depending on light conditions)





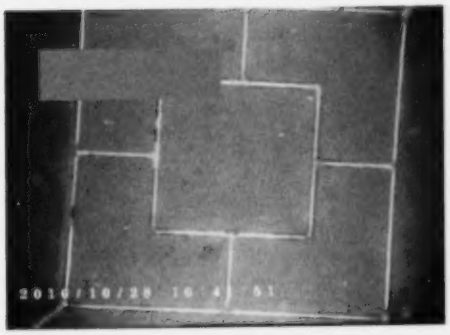
PHYSICAL INDICATORS

Flocculent Matter

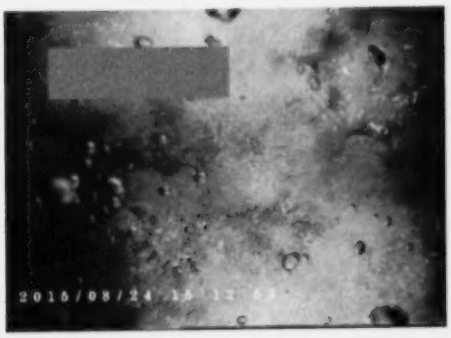
Accumulation of dark fluffy easily disturbed organic material (left picture has bacterial mats)

Barren

= no visible organisms



Off gassing



TAXA OF NATURAL COMMUNITIES

RHODOPHYTA

Red algae

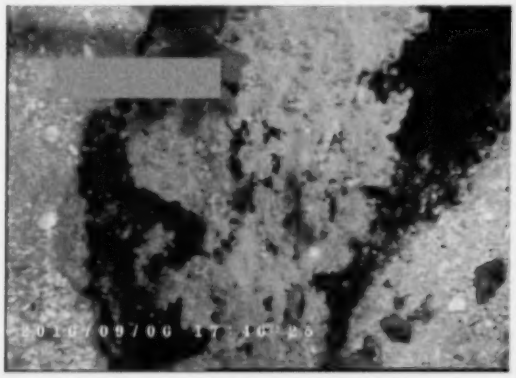
Note that except for encrusting forms (coralline algae and *Hildenbrandia)*, difficulties occur to determine genus or taxa family of Rhodophyta, and advice is to group them in a single group.

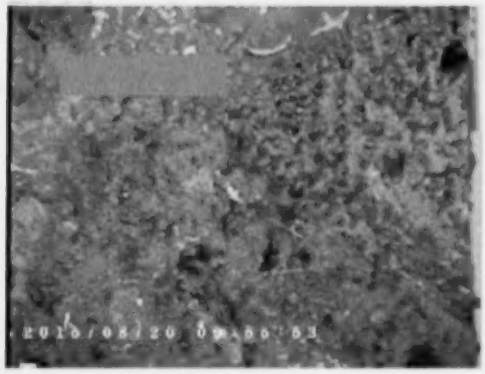
INCRUSTING ALGAE

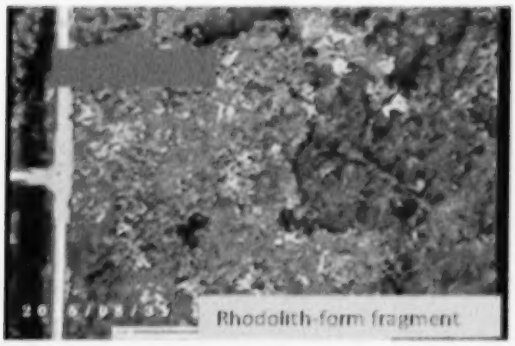
Rhodophyta[P] – Florideophyceae[C] – Corallinales[O] – Hapalidiaceae[F]

Coralline algae: *Lithothamnion* spp.[L] (likely of *L. glaciale*)

- Common name: coralline algae
- Description: calcareous (hard) and rock-like, encrusting coralline algae; can grow in individual branching, softball-sized chucks (called 'rhodoliths') or flat and encrusted on rocks and shells
- Size: no information, colonial form
- Colour: usually pink
- Habitat: often associated with *Hildenbrendia* sp. and over rock and gravel
- Frequency of observations: common.



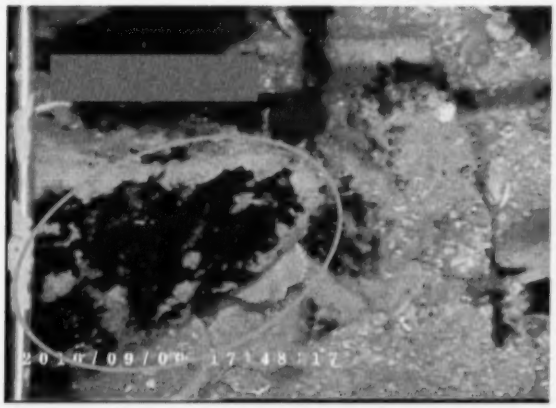


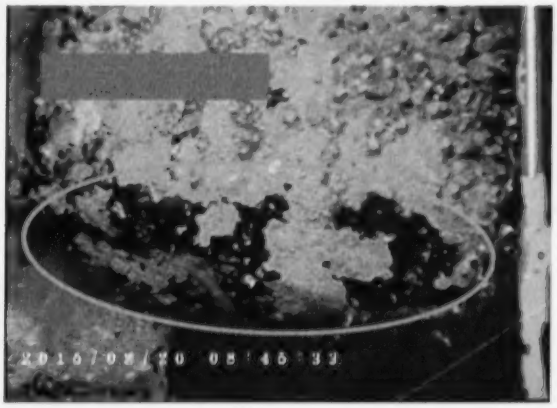


Rhodophyta[P] – Florideophyceae[C] – Hildenbrandiales[O] – Hildenbrandiaceae[F]

Hildenbrandia rubra[L]

- Encrusting on rocks
- Description: smooth, no raised bumps
- Size: no information, colonial form
- Colour: burgundy (much darker than *Lithothamnion*)
- Habitat: rocky substrate
- Frequency of observations: fairly common but less than *Lithothamnion*.

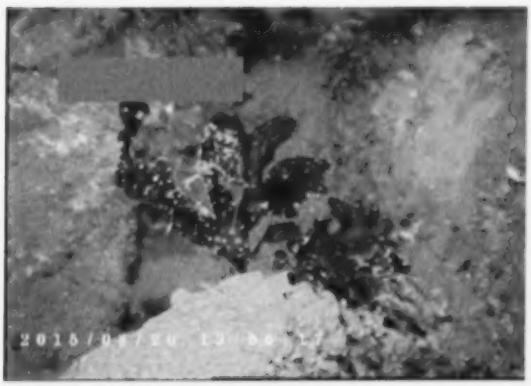


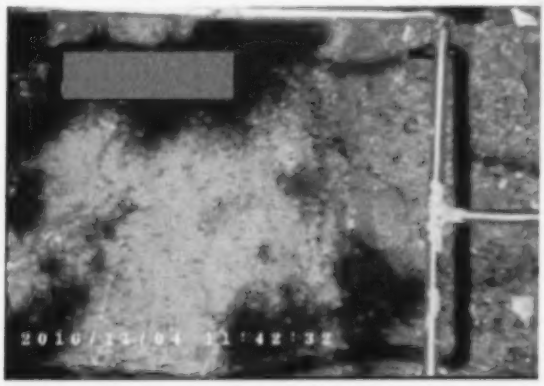


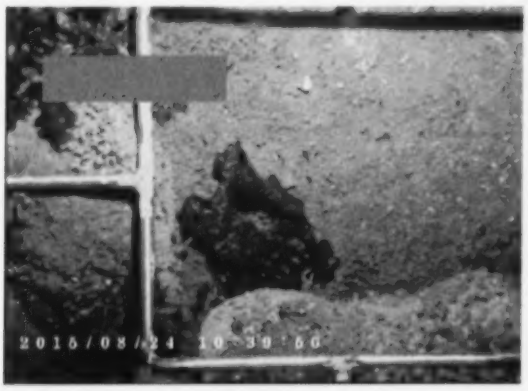
UPRIGHT FORMS

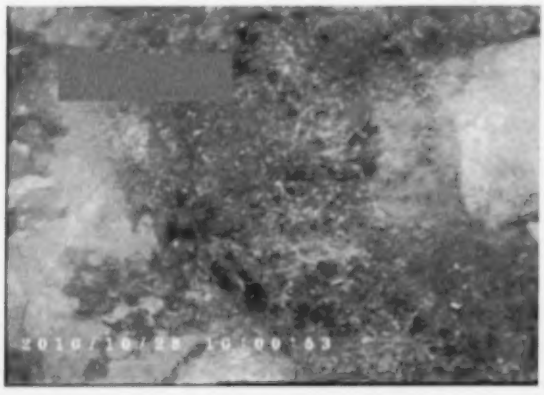
Due to the high number of species that can be confused linked to the quality of the images and the non-collection of specimen in this category, we advise that it might be better to classify as upright Rodophyta and potentially decline in species 1, 2 etc.

Rhodophyta[P]









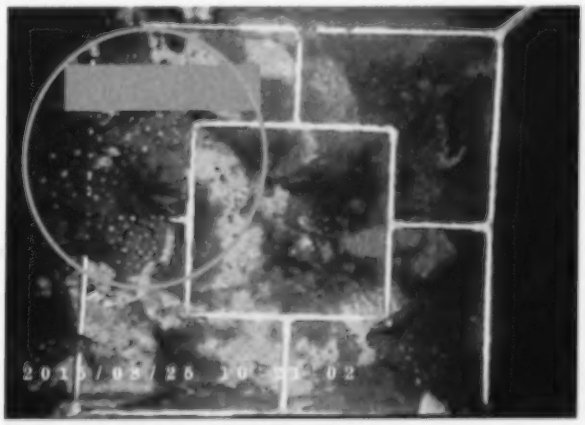
PHAEOPHYTA

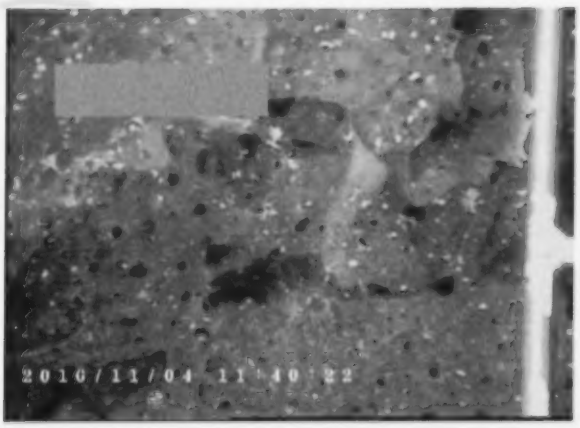
Brown algae

Ochrophyta[P] – Phaeophyceae[C] – Laminariales[O] – Costariaceae[F]

Agarum clathratum[L]

- Common name: sea colander, or colander weed
- Description: many small holes throughout flat blade
- Size: stipe up to 30 cm long; blade up to 90 cm long and 50 cm wide
- Colour: brown stipe and blade
- Habitat: in shallow water, from shallow subtidal zone to > 50 m depth
- Frequency of observations: common in shallow rocky waters.

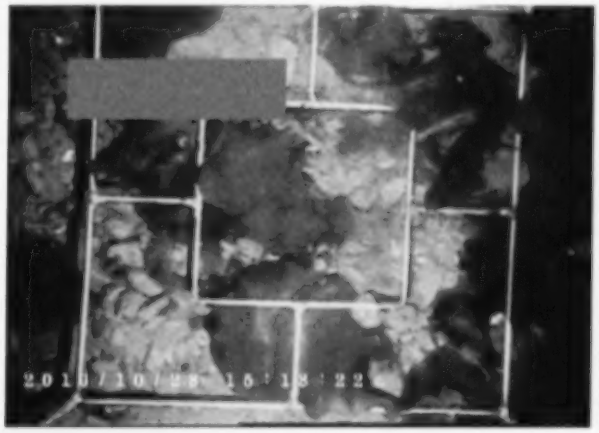


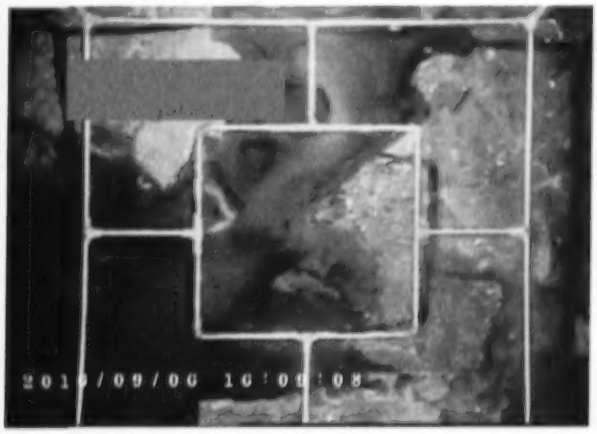


Ochrophyta[P] – Phaeophyceae [C] – Laminariales[O] – Laminariaceae[F]

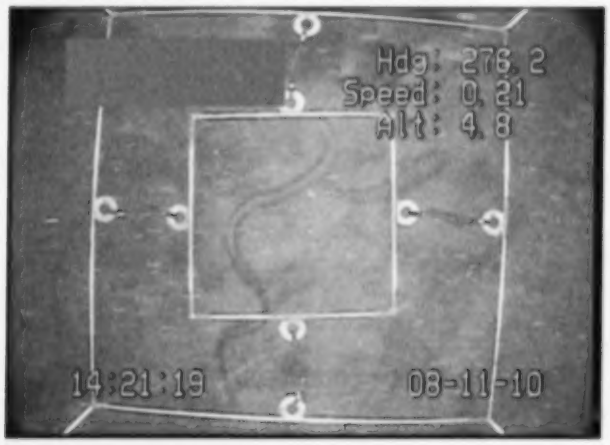
Saccharina longicruris [L]

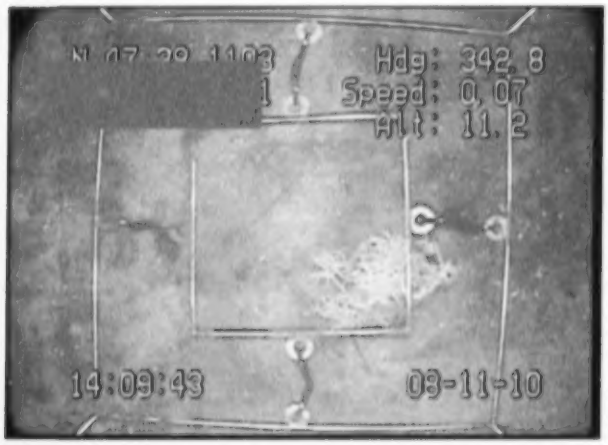
- Common name : kelp
- Description : brown algae constituting forests with large holdfasts, long stipes and large blades, holdfasts typically with extensive branching, used for attaching to substrate; blades with rippled appearance and extensive communities of epiphytes or parasite
- Size : variable between species, but blades up to 2-3 m long
- Colour: brown
- Habitat: common, in shallow water, up to > 50 m depth.





Holdfast and stipe.

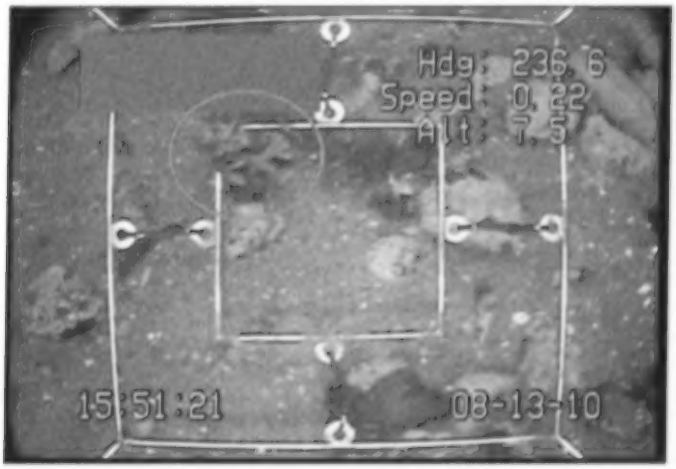




Ochrophyta[P] – Phaeophyceae [C] – Fucales[O] – Fucaceae[F]

Fucus spp.[L]

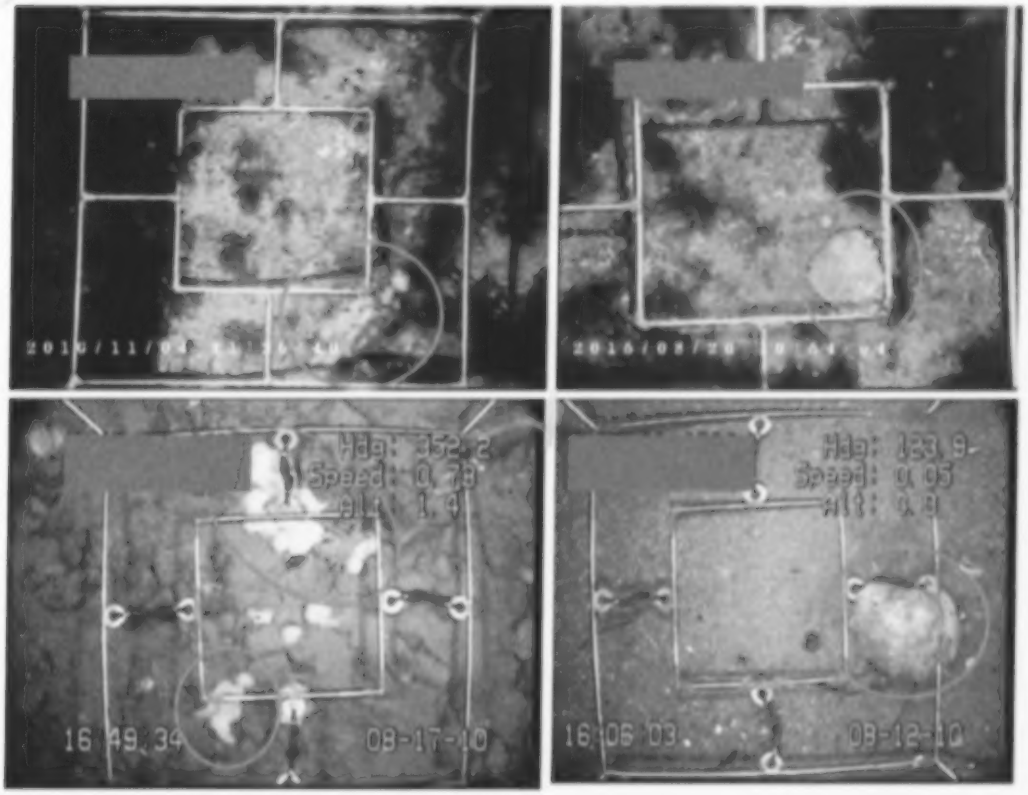
- Common name: No information
- Description: Branched thalli with multiple air vesicles (floats)
- Size: maximum 2 m height
- Colour: brown stipes and thalli
- Habitat: intertidal zone and shallow subtidal areas,
- Frequency of observations: rarely seen below intertidal zone.

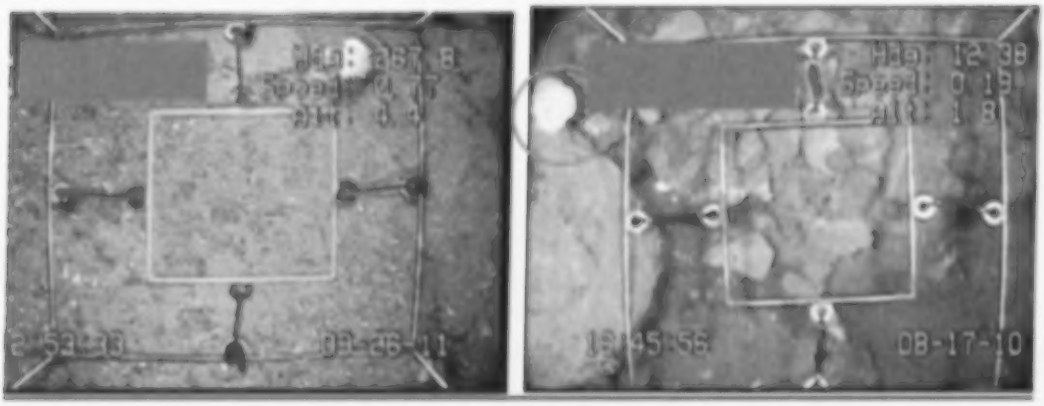


PORIFERA – SPONGES

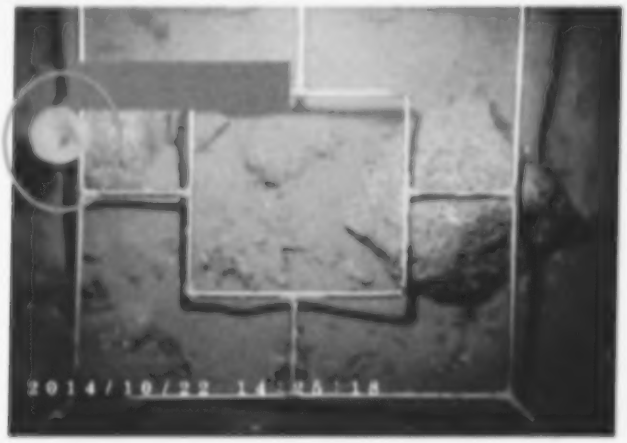
Porifera[P] (phylum level only considering difficulties in differentiating groups)

- Loose structure of cells and spicules (used for classification). Predominantly leuconoid in structure (high degree of folding, irregular pores and larger oscula for water circulation).
- Shape: upright branching, fan, vase, cushion, encrusting, or boring.
- Habitat: mostly marine, sessile and attached to hard substrates often on vertical or undercut surfaces.
- Taxa identification from images is difficult as shape, color and appearance of sponges may change according to environmental conditions and light. If resolution is optimal, refer to the *Sponge Identification Guide* NAFO Area (2010).





Vase-shaped sponge - ID unknown



CNIDARIA

Anemones, hydroids, jellyfish, corals

- Radial symmetry with central cavity
- Mouth surrounded by tentacles.

***Anthozoa*[C]** *- Anemones, soft corals*

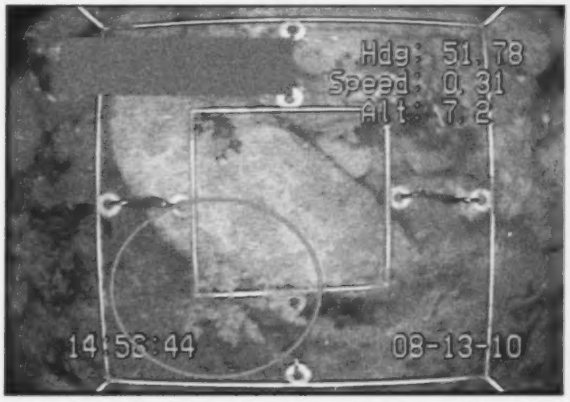
- For identification of anemones in video-based surveys, use: size, shape of stalk, shape of pedal disc, shape and number of tentacles, and habitat type; color being not always reliable.

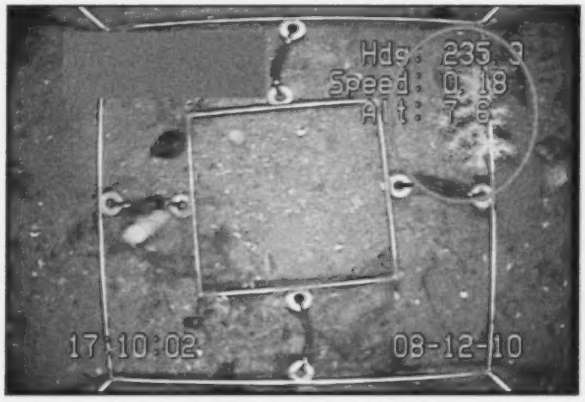
SOFT CORALS

Cnidaria[P] – Anthozoa[C] – Alcyonacea[O] – Nephtheidae[F]

Gersemia spp.[L]

- Common name: Gersemia
- Description: soft coral, cold water coral (no zooxanthella); arborescent colony, growing erectly with one main stem. Higher number of polyps at the branch tips that are unable to retract into the calyces and give an rounded shape at the end of the branches
- Size: 12 cm wide or larger
- Color : variable: red, brown, white, pink (ranges with light availability)
- Habitat : often grows over rocky substrate
- Frequency of observations: common
- Note: may be confused with other species.



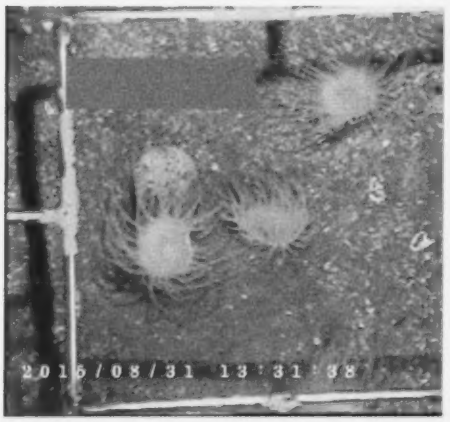


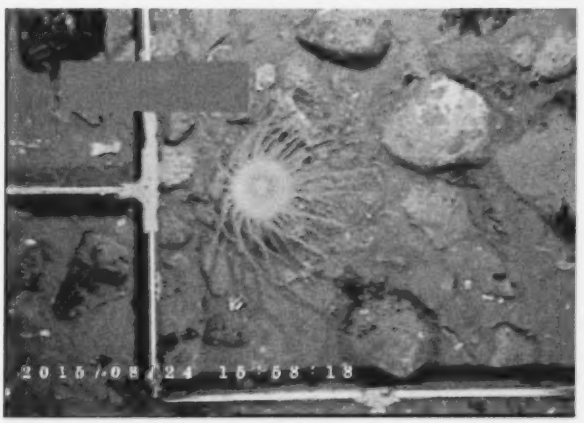
ANEMONES

Taxa discrimination is not easy using the level of quality of those images – some genus are easier to recognize than others. If uncertain, advice is to classify all anemones under the Actinaria order.

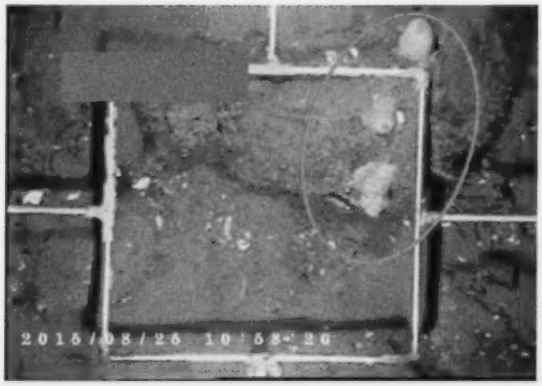
Cnidaria^{P} – Anthozoa^{C} – Actinaria^{O} – Hormathiidae^{F}

- Images quality precludes genus identification
- Description: oral disc approximately 5 cm wide, concave, with a bare center and pink protruding mouth; 30-50 long slender tentacles in several cycles, mostly along the edge. tentacles are relatively thin compared to other species; smooth column; Wide and quite apparent pedal disc that can be dislodged if disturbed
- Size: approximately 4 cm long, oral disc 5 cm wide
- Color: individuals appearing white or pink depending on light
- Habitat: commonly found, mostly seen attached to rock, often with column hidden in soft sediment
- Frequency of observations: common
- Discrimination between specimens alive or dead specimen is difficult.





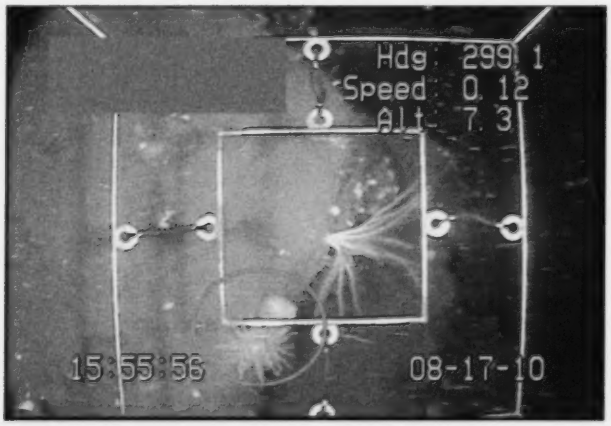
Individuals can be closed



Cnidaria[P] – Anthozoa[C] – Actinaria[O] – Actiniidae[F]

Urticina[L] spp

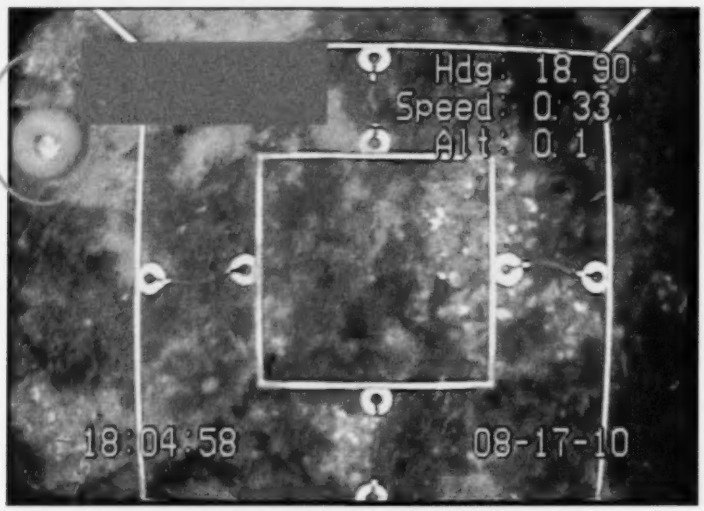
- Common name: No information
- Description: relatively thick blunt tentacles (tentacles thicker than Hormathiidae[F]) and a wide column
- Size: up to 7 cm diameter
- Color: varies; usually white, pink or red; colorful anemones
- Habitat : subtidal, can be confused with previous
- Frequency of observations: rarely observed.



Cnidaria[P] – Anthozoa[C] – Actinaria[O] – Metridiidae[F]

Metridium senile[L]

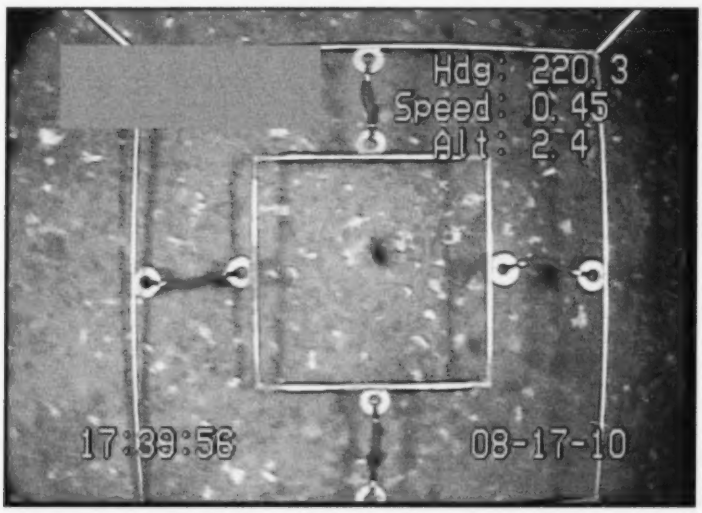
- Common name: frilled anemone
- Description: slender and numerous tentacles; when opened; individuals have a frilled appearance (no picture available) and present a white center when retracted (see picture)
- Size: column reaching about 20 cm high when open, disc about 10 cm in diameter
- Color: olive green column (may appear brownish in video), white tentacles (paler than column), individuals can also appear white
- Habitat: few information available, potentially rocky bottom
- Frequency of observations: rarely observed.



Cnidaria[P] – Anthozoa[C] – Spirularia[O] – Cerianthidae[F]

Pachycerianthus borealis[L]

- Common name: no information
- Description: two whorls of thin tentacles are visible at substrate level, can withdraw leaving a visible hole. The rest of the individual is embedded in the sediment and lacks a pedal disc. For larger specimens, column may be visible protruding from the sediment
- Size : up to 10 cm diameter
- Color: hazy hole in substrate due to tentacles with edges appearing red/brown
- Habitat : softer substrates, burrowing species
- Frequency of observations: rarely observed.



FIXED JELLYFISH

Cnidaria[P] – Staurozoa[C] – Stauromedusae[O] – Lucernariidae[F]

Lucernaria quadricornis (potentially)

- Common name: Stalked jellyfish
- Description :fixed jellyfish ;goblet shape individuals with eight arms organized in pairs; translocation by moving its stalk or even release the stalk and crawl on its "tentacles"
- Colour: usually light yellow or almost white but observation of green or brown individuals; individual in NL appeared pinkish (see picture) or light brown
- Size: up to 7 cm in height
- Habitat: subtidal zone, attached to algae or rocks, but it has been registered as deep as 550 m
- Frequency of observations: recently observed in Belle Bay, rare.

MOLLUSCA

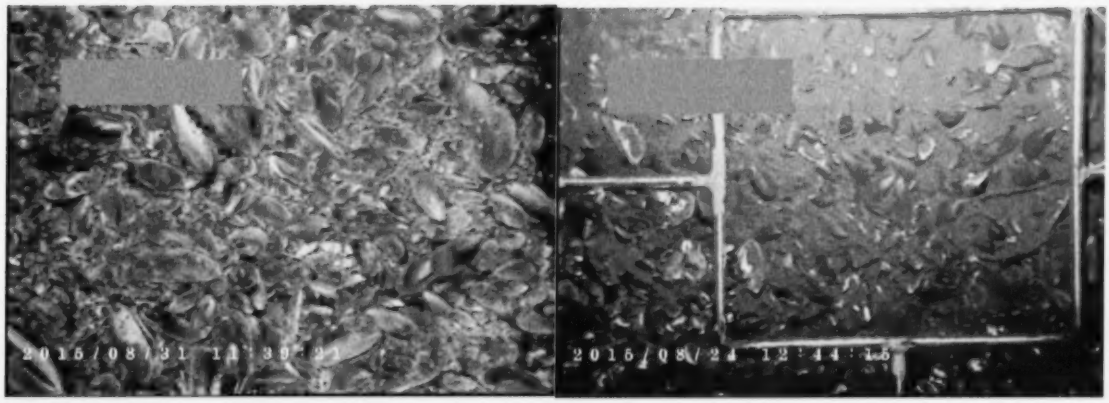
- Mussels, clams, scallops, whelks, periwinkles are common in NL waters. Soft bodied animals that typically secrete a calcareous shell
- Gastropods and clams were not included in this guide due to their low occurrence:
    - Periwinkles were not observed as they are in shallow water
    - Whelk shells but clearly non alive have been seen but rarely
    - Clams : never observed, should be within sediment.

BILVALVIA

Mollusca^{P} – Bivalvia^{C} – Mytilida^{O} – Mytilidae^{F}

Mytilus edulis or *M. trossulus*

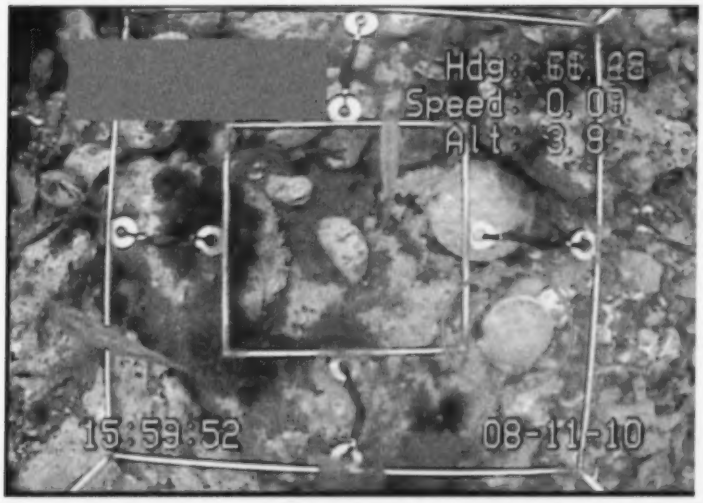
- Common name: Blue mussel
- Description: mussel external shell is composed of two hinged halves joined together on the outside by a ligament and a byssus for attachment to hard surfaces
- Size: maximum 8 cm in length
- Colour: grey-black
- Note : often natural shell deposition or as a result of aquaculture activities in the area
- Habitat: common close to cage, mostly dead individuals or clumps or forms a live bed mostly at shallow rocky depths (intertidal and shallow subtidal areas < 15 m).
- Frequency of observations: common close to cage, or in intertidal area.



Note: It is difficult to discriminate whether mussels are dead or alive. However, when observed agglomerated on the seafloor close to the cage edge (i.e. likely resulting from net fouling) with presence of deposition they are more likely dead.

Mollusca[P] – Bivalvia[C] – Pectinida[O] – Pectinidae[F]

- Common name: Sea scallops
- Description: large mobile bivalve clam with classic form shell
- Color : shell generally pinkish-red in color, with striped variegation to darker shades appearing in many individuals
- Size: up to 20 cm shell diameter
- Habitat: no information
- Frequency of observations: common dead shell (used shell, see picture) ; rare alive individual.



ANNELIDA

Segmented worms (marine bristle worms and leeches)

Polychaeta[C] – Marine bristle worms

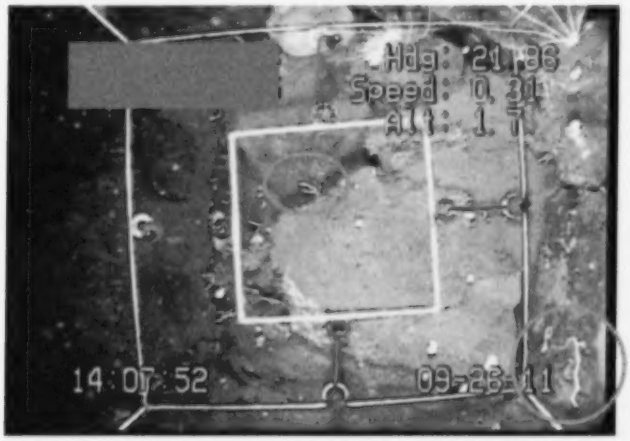
- This group includes burrowers, errant or tube-forming worms
- In video-based surveys, the tube material (e.g. mud, calcareous) and its shape (e.g. cone), can be useful in identification.

Annelida[P] **– Polychaeta**[C] **– Sabellida**[O] **– Serpulidae**[F]

Serpula[L] sp.

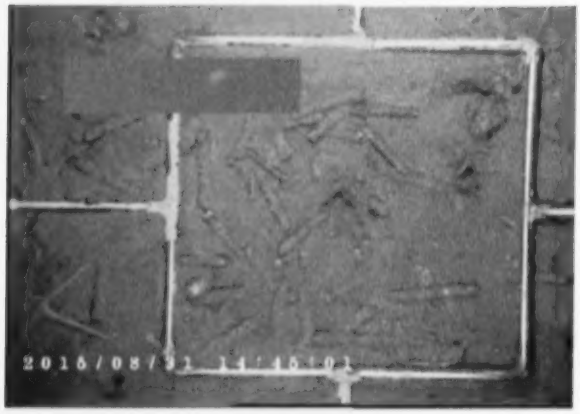
- Common name: Serpulids, calcareous tubeworm, serpulid tubeworm, fanworm, or plume worm
- Size: no information
- Description : calcareous tube-dwelling worm attached to rocks, sessile suspension feeder with colorful fan-shaped crown (gills) when open
- Color: usually white tube, colourful gill crown
- Habitat : boulders and rockwall
- Frequency of observations: common at some sites but absent at others

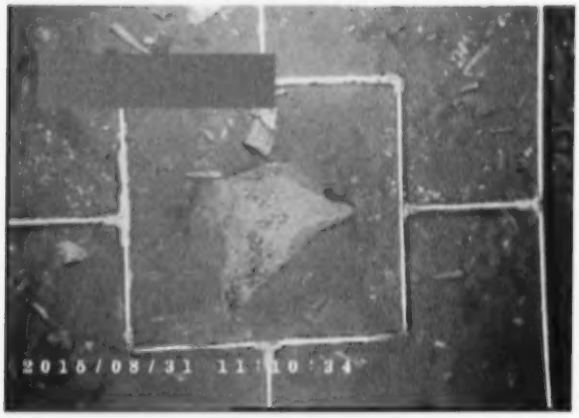
- Note: tube may be empty; difficult to determine if the organisms are alive or dead when the gills are not out.



Annelida[P] – Polychaeta[C] – Terebellidae[O] – Pectinariidae[F]

- Common name: ice cream cone worms or trumpet worms (*Pectinariids*)
- Description: build tubes using grains of sand (shape of ice cream cone or trumpet) ; tube-dwelling sessile worms
- Size: maximum 5 cm
- Colour : cryptic with sediment, worms appear pink
- Habitat: usually seen over softer sediments and barren areas
- Frequency of observations: common
- Notes:
    - Tubes can be empty : difficulty to determine if specimens are alive
    - When available on camera, zooming often helps for discrimination and counts.





ECHINODERMATA

Sea stars, brittle stars, basket stars, sea cucumbers, urchins, sand dollars, feather stars (crinoids).

- Radial/pentamerous (typically pentaradial) symmetry
- Locomotion by tube feet
- For identification in video-based surveys, use overall shape and color, morphology and number of arms, habitat type

Note: sand dollars can be seen but are rare and do not figure in the guide.

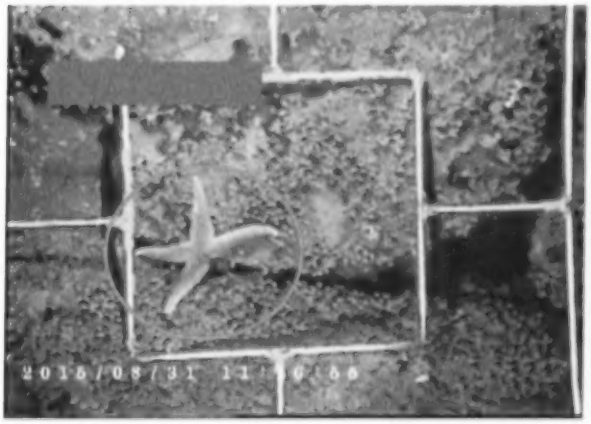
SEA STARS

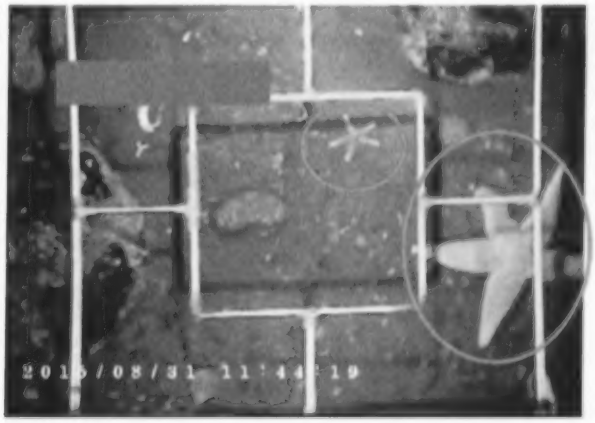
If species / taxa determination cannot be achieved, sea stars are classified as unknown Asteriidae Family of echinoderms

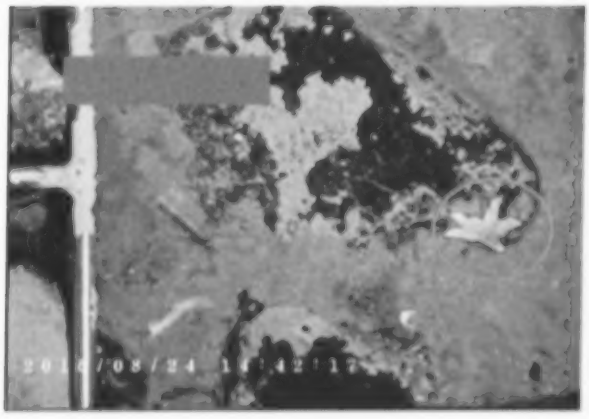
Echinodermata[P] – Asteroidea[C] – Forcipulatida[O] – Asteriidae[F]

Asterias rubens[L]

- Common name: sea star, starfish
- Description: typically 5 arms but could be less due to body damage
- Size: typically up to 20 cm in diameter
- Colour: variable, usually pale orange, red, or purple
- Habitat: all habitats
- Frequency of observations: mainly present in shallow rocky areas



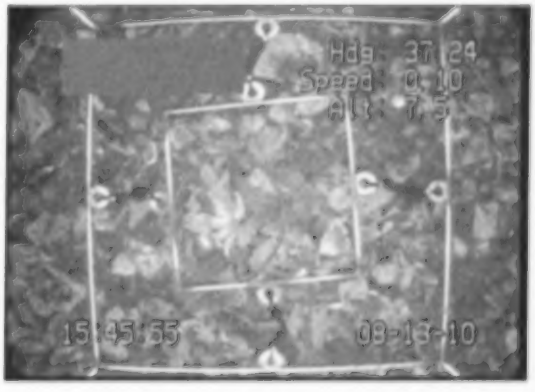




Echinodermata[P] – Asteroidea[C] – Forcipulatida[O] – Asteriidae[F]

Leptasterias polaris[L]

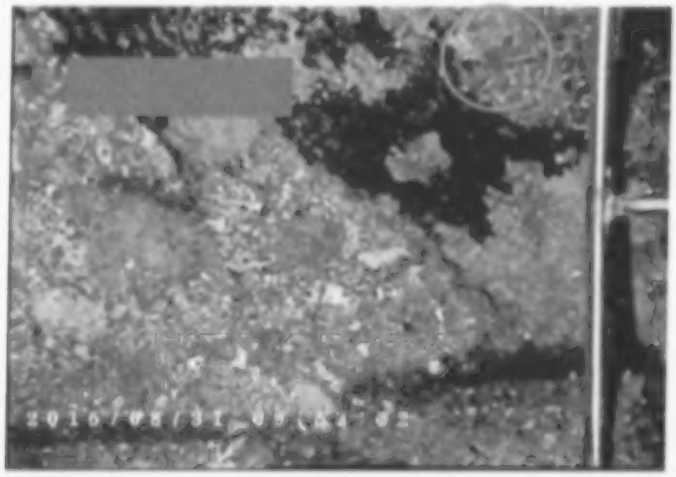
- Common name: Polar sea star
- Description: similar to common sea star but has six arms
- Size: maximum of 30 cm in diameter
- Colour: mottled pink/purple and white
- Habitat: typically in same habitat as *A. rubrens*, however may be found in deeper, colder waters
- Frequency of observations: rarely observed.

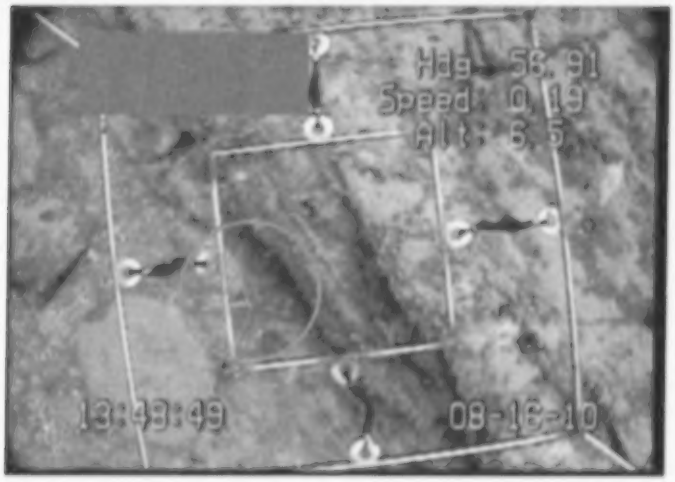


Echinodermata[P] – Asteroidea[C] – Spinulosida[O] – Echinasteridae [F]

Henricia sanguinolenta [L](potentially)

- Common name: Blood star
- Description : typically have 5 arms
- Size: generally smaller than *Asterias* and *Leptasterias*, up to 10 cm in diameter.
- Colour: bright red, purple, or orange, but can appear dull in low light
- Habitat: all habitat type; few information
- Frequency of observations: rarely observed.

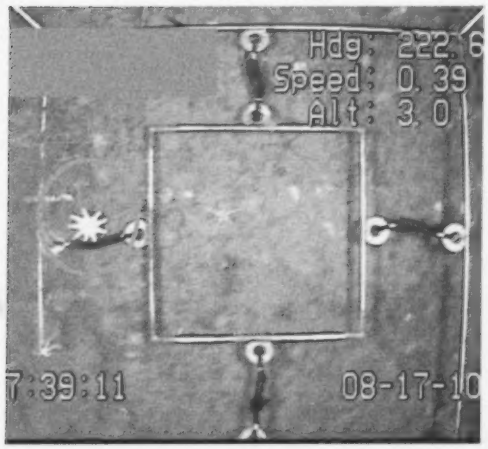


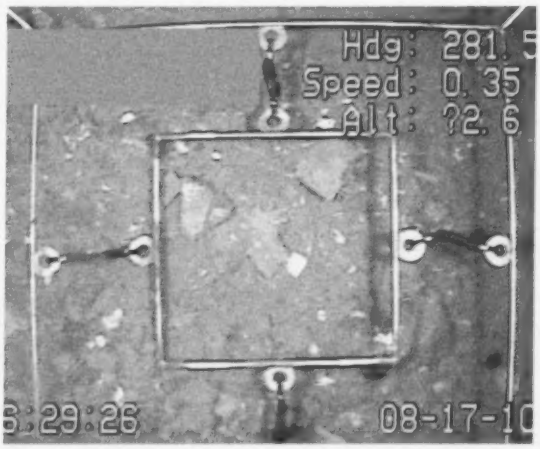


Echinodermata[P] – Asteroidea[C] – Valvatida[O] - Solasteriidae[F]

Crossaster papposus[L]

- Common name: Spiny sun star
- Description : sea star with 8-14 arms
- Size: maximum 30 cm in diameter
- Colour: typically pink/purple; potential to see concentric bands of alternating colour (typically white) on underside
- Habitat: rocky or gravel areas, few information
- Frequency of observations: rare.



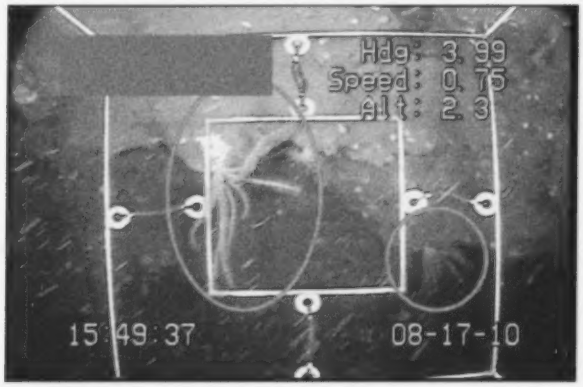


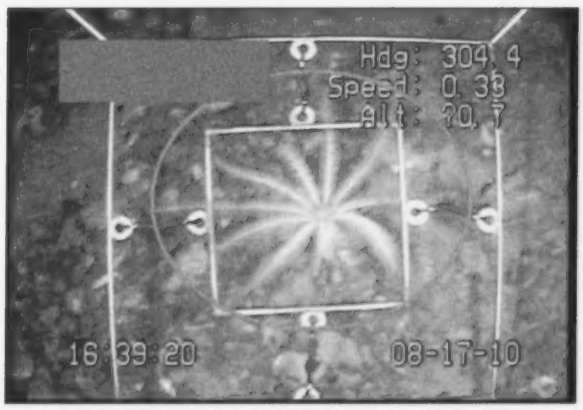
CRINOIDS

Echinodermata[P] - Crinoidea[C] – Comatulida[O] - Comasteridae[F]

Heliometra glacialis[L]

- Common name: Crinoid or feather star
- Description : suspension feeders; ten feathery arms ; No stalk, attaches to substrate using short cirri that are barely visible when detached
- Size: up to 20 cm in length
- Colour: white or orange
- Habitat: common over bedrock
- Frequency of observations: common over bedrock.



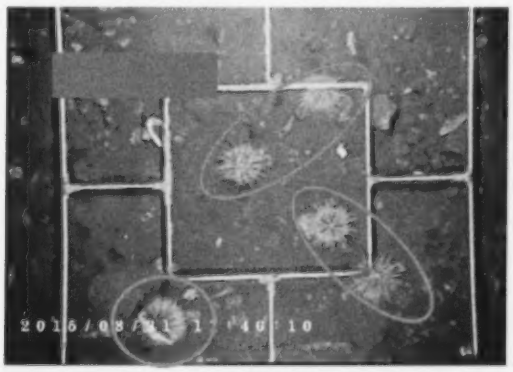


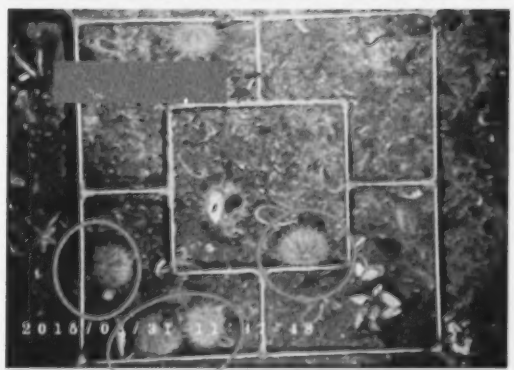
SEA URCHINS

Echinodermata[P] – Echinoidea[C] – Camarodonta[O] – Strongylocentrotidae[F]

Strongylocentrotus droebachiensis[L]

- Common name: Green sea urchin
- Description: Numerous long spines present when individual is alive and test without spines when dead
- Size: shell diameter of approximately 8 cm (adult)
- Colour: green-grey
- Habitat: depth < 70 m
- Frequency of observations: relatively common.



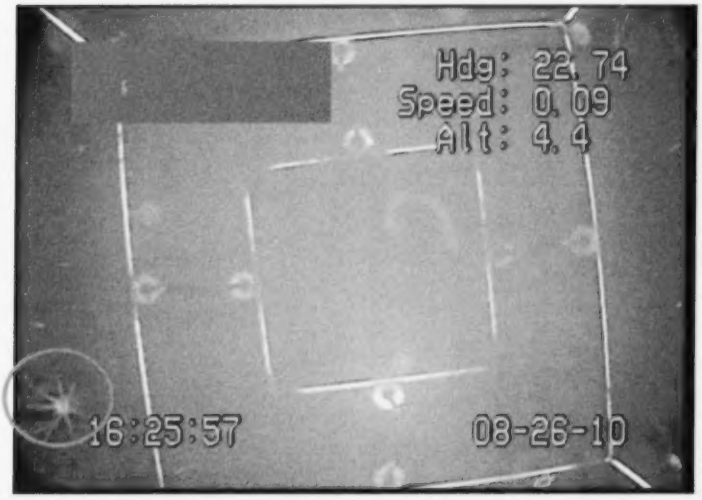


SEA CUCUMBER

Echinodermata[P] – Holothuroidea[C] – Dendrochirotida[O] – Cucumariidae[F]

Cucumaria frondosa[L] (main species present in Newfoundland)

- Common name: Orange-footed sea cucumber
- Description: suspension feeder echinoderm. Cylindrical / tube-shaped elongated individuals. Oral end surrounded by ten branching tentacles; Leathery skin with five rows of tube feet used for locomotion and attachment. Flexible body that can tighten into a knot or cam blow up like a beach ball to roll away from predatory sea stars
- Size: maximum 50 cm long and 10 cm diameter
- Colour: tentacles orange-red to black
- Habitat: usually in a wide range of habitats and depths but in NL prefers <30 m, typically rocky to sandy areas
- Frequency of observations: rarely seen
- Note:
    - Not often observed
    - Other species described in NL : *Psolus fabricii* (bright orange) and *Psolus phantapus* (peach to orange colour) that burrows in the sediment with only the tentacles being visible above the surface of the sediment
    - More information is available: http://www.fishaq.gov.nl.ca/research_development/fdp/pdf/sea_cumcumber.pdf
- Note on picture: this image is a top view of the mouth of the cucumber vertical to the seafloor.



OPHIUROIDS

Echinodermata[P] – Asteroidea[C] – Ophiurida[O] – Ophiolepidae[F]

- Common name: serpent star or brittle star
- Description tend to be cryptic with the habitat if possible (live in crevices and under rocks and raise arms to capture food, suspension feeder)
- Size: variable
- Colour: aboral surface orange or light brown
- Habitat: all substrate; more difficult to see over softer substrates, sometimes only arms are visible
- Frequency of observations: common.

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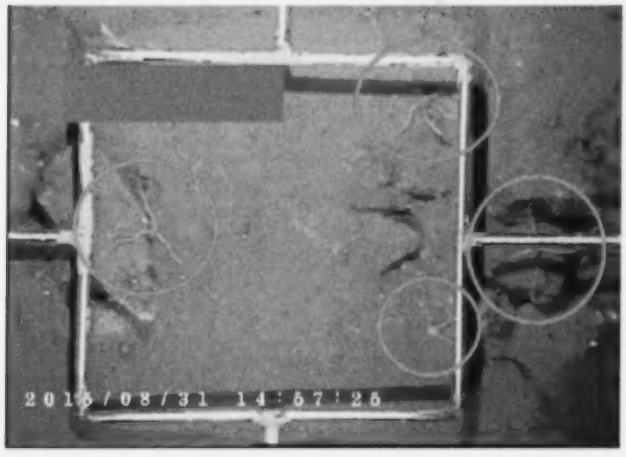
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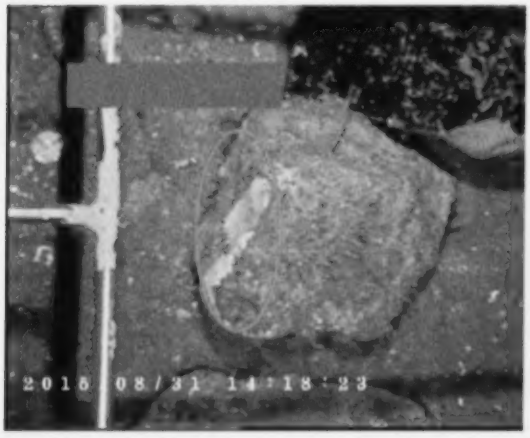
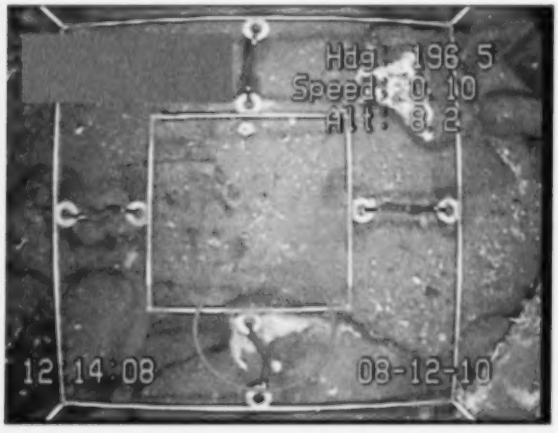
UNDEFINED/CRYTIC SPECIES/TAXA

Some taxa such as ascidians and tunicates have not been reported here and might be the results of misidentification due to image quality and must have been confused with sponges.

- Example: impossible to detect if it is a sponge or a colonial ascidians (*Didemnum albidum*?)





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